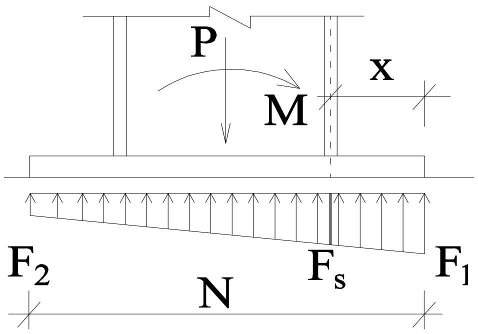
Design of Base Plate Bearing on Concrete Subjected to Small Eccentricity, e ≤ N/6



Loads

Dead Load, P_D=			50 kips
Live Load, P_L=			90 kips
Moment from D.L., M_D=			100 kip*in
Moment from L.L., M_L=			180 kip*in

Base Plate Material Properties

Grade:	SEL("Material/ASTM"; NAME;)	=	A36
Yield stress, f_{yp}=	TAB("Material/ASTM";F_y;NAME=Grade)	=	36 ksi

Column, Base Plate and Pedestal Dimensions

Concrete strength for pedestal (f'$_c$):

f'_c=			3 ksi
Sec.:	SEL("AISC/W"; NAME;)	=	W10X112
Pedestal depth, P_d=			17 in
Pedestal width, P_w=			14 in
Base plate depth, N=			17 in
Base plate width, B=			14 in
Depth of column, d=	TAB("AISC/W";d; NAME=Sec.)	=	11.4 in
Flange of column, b_f=	TAB("AISC/W";b_f;NAME=Sec.)	=	10.4 in

Check Eccentricity Size

M_t=	M_D+M_L	=	280 kip*in
P_t=	P_D+P_L	=	140 kips
e=	M_t/P_t	=	2.00 in
Check_e=	IF(e≤ N/6;"O.K.";"not O.K.")	=	O.K.

(Note that: if this check was not O.K., this template will give a wrong solution)

The Ultimate Load and Moment

(Chapter 2 of ASCE/SEI 7)

P_u=	$1.2*P_D+1.6*P_L$	=	204 kips

M_u= $1.2*M_D+1.6*M_L$ = 408 kip*in

The Maximum Bearing Stress, F_b

Φ_c= 0.60

A_1= N*B = 238.00 in^2

A_2= P_d*P_w = 238.00 in^2

F_{b1}= $0.85*\Phi_c*f'_c*\sqrt{(A_2/A_1)}$ = 1.53 ksi

F_{b2}= $1.7*f'_c$ = 5.10 ksi

F_b= $MIN(F_{b1};F_{b2})$ = 1.53 ksi

F_1= IF(Check_e="O.K."; $\frac{P_u}{A_1}+\frac{M_u*N/2}{(B*N^3)/12}$; " ") = 1.46 ksi

F_2= $\frac{P_u}{A_1}-\frac{M_u*\frac{N}{2}}{\frac{B*N^3}{12}}$ = 0.25 ksi

Check_F= IF(F_1<F_b;"Safe";"Unsafe") = Safe

Base Plate Thickness:

The critical section is at distance (x) from the plate edge, where:

x= $\frac{N-0.95*d}{2}$ = 3.09 in

The distance form the base center to this section (x_1) and the stress at this section (F_s) can be calculated as:

x_1= $\frac{N}{2}-x$ = 5.41 in

F_s= IF(Check_e="O.K."; $\frac{P_u}{A_1}+\frac{M_u*x_1}{(B*N^3)/12}$; " ") = 1.24 ksi

The factored moment for a 1-in strip at this section (M_s) can be calculated as follows:

M_s= $\frac{F_s*x^2}{2}+(F_1-F_s)*\frac{x^2*0.67}{2}$ = 6.62 kip*in

$t_{p,min}$= $\sqrt{\frac{4*M_s}{0.9*f_{yp}}}$ = 0.90 in

Summary: Use Plate with The Following Minimum Dimensions

Plate length= N = 17 in

Plate width= B = 14 in

Plate thickness= $t_{p,min}$ = 0.90 in